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A New Philosophy of the Sun.

— A PAPER —

READ BEFORE

THE CHAUTAUQUA SOCIETY OF HISTORY

AND

NATURAL SCIENCE,

BY

HENRY RAYMOND ROGERS, M. D.

DUNKIRK, N. Y.



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A New Philosophy of the Sun.

By Dr. HENRY RAYMOND ROGERS, DUNKIRK, N. Y.

WHAT is the Sun? This question has been asked by sages and philosophers in all ages and in all tongues since the birth of Science; but, in the words of a writer distinguished in this field, "The riddle of the sun is yet unread." Even the telescope, though it has virtually reduced the sun's distance from 93,000,000 to 180,000 miles, has failed to reveal its essential nature or the secret of its powers. The chaos in which this subject is involved is strikingly pictured by an eminent scientist in a recent work entitled "The Sun." He says: "We have a great collection of isolated facts, but are wholly in the dark as to how they are to be grouped and explained. It is not too much to say that the origin of all we really know of the physical condition of the sun, and of the extraordinary changes going on upon it, is due to the occasional occurrence of total eclipses. Unsatisfactory though this may be, our whole knowledge of solar physics is almost equally unsatisfactory." He thus candidly acknowledges our entire ignorance of the physical condition of the sun. This confession of one of the highest and most recent authorities is unquestionably a true expression of present scientific thought.

What, it may be asked, is the prospect of the solution of this great mystery in the early future? It is safe to say, that it will not be solved while mankind is so firmly held, as at present, by ancient traditions. The recognition of the pro-

found simplicity of the general laws of nature will do more towards delivering us from the bondage of these traditions than all other causes combined. Our hope lies in clear and unbiased perceptions of the sun's phenomena, and in simple and rational interpretations of those phenomena.

In the study of the sun, superficial appearances have been too confidently trusted. The sun appears hot and bright, and we unthinkingly accept these evidences as true, even in the face of facts which prove them delusive. Science has ever taught and now teaches that the sun is inherently hot; that it is virtually a great incandescent ball, which incessantly projects or radiates actual heat and light supplied from its own abundance, in all directions and to all distances into space. A distinguished scientist expresses the sentiment almost universally entertained when he says, "There can be no doubt that if the sun were to come as near us as the moon, the solid earth would melt like wax." Yet no fact is better understood than this, that heat rapidly decreases in the direction of the sun. At the elevation of one and one-half miles in this latitude, and of three miles at the equator, snow and ice never melt, either in summer or in winter. Mountain tops are perpetually covered with snow. One of the most distinguished of aeronauts, Mr. Glaisher, tells us, "At great heights no difference is observed in the reading, between the thermometer with the sun shining full on its bulb, and another in which the bulb is carefully shaded."

Again, the sun, earth and stars perpetually revolve in the cold of space, which cold is variously estimated at from hundreds to millions of degrees below zero; according to Secchi, eighteen million degrees below. Through such a distance as 93,000,000 miles, and through so cold a medium, who can suppose that heat, as heat, could possibly reach the earth from the sun? How absurd it is, therefore, to claim that the sun is actually hot, or that the slightest degree of heat can maintain an existence in space. For this reason we make the general statement that since sun, moon and stars move in this inten-

sity of cold, consequently not one of these can radiate the slightest degree of heat beyond the superficial confines of its own atmosphere. Therefore it is safe to assert that the sun is not hot.

The sun *appears* bright. No one questions its apparent brilliancy. But is it indeed bright? Science teaches that both the sun's heat and light are due to essentially the same process, and that they are subject to the same laws. If heat, therefore, diminishes sunward, so also must light diminish sunward. This fact is now abundantly demonstrated. Capt. Abney of the Royal Society, London, found, upon measurement, that at the elevation of simply one and one-half miles, the light of the atmosphere was only from one-tenth to one-twentieth as great as at the surface of the earth. At a little over three miles, the sun appears no brighter than our moon, and at four miles, the sun's rays are no longer capable of producing the colors of the solar spectrum. At that elevation the spectroscope shows only the yellow; *and that, too, without lines*. The sun, therefore, may be regarded as not inherently bright.

If, then, the sun be neither hot nor bright, what becomes of our boasted philosophy of that body? The most important conclusions become necessitated. Since inherent heat and brilliancy are disproved as existing at the sun, why any longer should the sun be supposed to have a different physical constitution from that of the earth? Indeed, to the inhabitants of other worlds the earth appears bright, even as Venus, Mars and Jupiter appear bright to us. But in what can the earth's brightness consist? We, its inhabitants, see nothing of it, know nothing of it, through any appearance presented to us, yet the fact is unquestionable. Now, if the earth be bright in appearance, and devoid of sensible heat, analogy would teach that the sun and all other bright worlds are to their own inhabitants neither bright nor hot, though having that appearance to us. It is a natural inference, therefore, that the sun, moon and all stars, are constituted identically the

same as the earth, with inhabitants, mountains, oceans, streams and fields the same.

The identity of constitution of the celestial spheres is daily becoming more firmly established as a fundamental principle in philosophy. Dr. M. Meyer recently said before a body of distinguished scientists in Berlin: "The sun is composed of the same materials as the earth. The distant fixed stars are of a composition identical with that of the sun. The uniformity of nature's laws and the similarity of the materials composing the universe are a sufficient proof that there must be organizations similar to that of our system all over the universe." He also said: "We must conclude that the earth is inhabited by a small family which forms part of the great nation that peoples the universe." M. Faye says: "Nothing really distinguishes our sun from the multitude of stars which shine in the heavens." Helmholtz says: "What the earth does is done by all the other spheres and in a higher degree by the sun." There are no known facts which disprove such identity of constitution of all worlds.

We have seen that the sun is not hot, that it is not bright; that heat and light are not, therefore, among its essential constituents and, moreover, that they are not found in the universal space. And yet we must certainly attribute to the sun the effects of heat and light. And until these effects are satisfactorily accounted for it will be utterly in vain that we say the sun is not hot and that it is not bright. No one will believe us. It must be shown that the sun, in conjunction with the earth, has some mysterious operation, the result of which is heat and light; and this is just what we now propose to do. We claim that there is a force acting through the sun upon the atmosphere of the earth, causing heat, light and chemical action therein. This force, or current of force, incessantly comes from the sun, earthward, and, whatever its essence may be, it has not the form or the nature of heat and light until transformed into these through contact with the atmosphere.

In our atmosphere, therefore, and not at the sun, the so-called sunlight and sunheat are developed.

Our old and cherished conceptions of the sun, of its marvels of heat and brilliancy, thus become rudely dispelled.

There is a power of mysterious qualities, already well known as a producer of heat and light, that is capable of acting between the sun and earth. That power is Electricity. That electrical action takes place between the sun and earth has been held for more than a century. But, it may be asked, what is the proof of such electrical relationship? As a demonstration of the action of electricity between the sun and earth we cite the following facts: In the year 1859, two bright sun spots appeared instantaneously upon the sun's disc, and simultaneously with their appearing there followed violent electrical effects over a large portion of the earth. In the northern regions, where the temperature of the atmosphere was far below zero, Dr. Scoresby converged the sun's rays to a focus by means of a lens made of ice, and exploded gunpowder, set fire to combustibles, and melted lead. To prove that these rays are electrical we have only to state the fact that by rendering electrical rays parallel and sending them through a lens of ice we produce the identical effects obtained by Dr. Scoresby with the rays of the sun. Actual heat rays are incapable of passing through a lens of ice. The distinguished scientists, Zantedeschi and Barlocchi, demonstrated that magnets both acquire and lose strength as their poles are relatively exposed to the direct rays of the sun; gaining strength, even more than doubling it, when the north pole is thus exposed and losing strength when the south pole is exposed. They also discovered that by concentrating the rays of the sun upon the magnet by the use of a lens the effects were intensified. To produce these effects it is clear that the sun's rays must be electrical or magnetic. The sun could neither add to, nor take from, the power of the magnet except its rays were of a like character. In these several experiments, therefore, we have incontrovertible evidence of instantaneous and incessant elec-

trical action between the sun and earth, and, inferentially, between all celestial spheres. It has been demonstrated that vacuum is the most perfect condition for electrical transmission, therefore no medium for such transmission is needed. So far as electrical action between the sun and earth is concerned, distance is virtually annihilated, and hereafter those bodies may be studied as if standing side by side.

Since electricity is thus claimed to be the great interstellar force, the universal force, and since such marvelous powers and properties are attributed to it, the question arises, what is electricity? What electricity is, essentially, yet remains a mystery. Our knowledge of what it is, is derived from what it does. We have no experience of its independent existence, and it may, therefore, be regarded simply as a product. Whether electricity is evolved on the scale of the universe or of the atom, it must necessarily be due to identically the same processes and subject to the same laws. For a century, electricity has been diligently studied and its processes carefully observed, until it may be said that now its *modus operandi*, both of development and action, has become familiar to all. Generically, it includes magnetism. So intimately are the two related that we cannot electrize a substance without magnetizing it, and we cannot magnetize it without electrizing it. Electricity appears to be the agent in its active form, and magnetism the same agent in its passive or static form.

A fundamental principle in electrical philosophy is that electricity is evolved from the joint action of motion and magnetism. Faraday, who stands unrivalled as an authority, says: "The rotation of all bodies opposite to magnets induces circulating electric currents. To obtain electricity from magnetism it is necessary to super-add, to the latter, motion." Those masters in this field, Guéricke and Volta, confirm and supplement these statements of Faraday. They experimentally verified the fact that every movement of one body near another disturbs and puts in motion the electric current in both bodies. These facts are made manifest by innumerable experi-

ments; thus, by rubbing a piece of amber or glass electricity is evolved, and a person by shuffling his feet over a carpet may develop sufficient electricity to light a gas-jet with his finger. It is verified more strikingly in such an experiment as that given by Mr. Reese, of Pittsburgh, Pa. From a sheet of thin, soft iron or steel he cut a circular disc forty-two inches in diameter. Fitting this disc to an axis and causing it to revolve with great velocity he cut off bars of hardened, polished steel, three inches in diameter. This revolving disc at no time touched the bar of steel which it severed, and it was not raised in temperature, though sparks flew about and drops of liquid steel fell from the cut. The atoms of steel held by the electrical force of cohesion became loosed by the action of a stronger electrical force, due to the rapidly revolving wheel, and their relations became changed. Those sparks and drops were not hot.

Upon the principle of the reciprocal action of motion and magnetism is constructed the dynamo-electric machine with which we are now familiar, and which gives us our electric light, heat and power. This machine is constituted essentially of two parts, a revolving armature and stationary magnets. The armature revolving with great velocity near to, but not touching, the magnets develops electricity, ready to be carried from the machine by wires, on its mission of light-production or other work. Thus motion and magnetism, acting reciprocally, give to man his intensest light and heat.

Extending this principle from the lesser or terrestrial to the grander or celestial field, the inference becomes legitimate that the stellar worlds, whirling in space, evolve between them electrical currents in great cosmical circuits; that the sun and earth revolving on their axes and in their orbits constitute a vast terra-solar electrical machine, to the action of which is due the currents which incessantly come from the sun to the earth.

Our earth is known to be a vast magnet and its atmosphere is stored with the magnetic quality. Flammarion says: "The

globe is one vast reservoir of this subtle fluid which exists in all worlds appertaining to our system, and of which the radiating focus is the sun itself. Its palpitations sustain the life of the universe." This universal magnetism of the earth and all spheres is purely potential, or static, and incapable of acting, or moving, except as excited by the celestial motions. Through these motions, therefore, this static magnetism becomes converted into vital, active, electrical currents. These grand interstellar currents, thus generated like those of our diminutive machines, act through positive and negative conditions and involve a circuit between the sun and the earth. If currents come from the sun, it follows, both by the laws of electricity and the law of conservation of force, that equal currents do return thither from the earth. Equilibrium is a fundamental law of the universe. Herein we find the great cosmical circuits, not alone between sun and earth but between all celestial spheres as well.

The conception that the motions of the heavenly bodies are the actual source of the universal force is not new. It has been entertained from time to time by certain most distinguished philosophers. Humboldt tells us that Aristotle, "The Father of Science," held, "that all telluric phenomena, every conceivable form of force, must be ultimately referable to the impulse of the motions of the heavenly spheres. All changes in the physical world may be reduced to motion." But the motions of the sun, earth and stars, with all their possibilities of force, would possess no practical efficiency if those bodies were isolated in vacuous space as they appear to be. Their vast energies must operate through actual and direct intercommunication.

The sun stands as the representative of force in our solar system. Its power may be presumed to reside in its mass and its motions. The extent of power embodied in a mass of matter in motion is calculated by multiplying the velocity in feet per minute by the weight in pounds. The immensity of the sun's power, therefore, may be gathered from the state-

ment of its mass, and its velocity, both rotary and progressive. The adequacy of this force for all demands which may be made upon it cannot be questioned. The same process applied to the innumerable host of the celestial bodies must satisfactorily express the aggregate force of the universe. This fact being recognized, the duty of the hour is to apply this principle in explanation of existing phenomena, to show how the motions of the celestial bodies in their stupendous masses and inconceivable velocities may be converted into available energy.

Although philosophers have imagined that the universal power might in some way be traced to the celestial motions, yet never has an exact philosophy been advanced whereby it could be shown that those motions developed actual force. Indeed such a philosophy of explanation has remained wholly impracticable down to the present period; and it is now made possible mainly by reason of the light of recent discoveries and inventions. Through these we now claim to have discovered the true source of all cosmical power, to comprehend how the sun and all the stars have been put in harness, so to speak, for the performance of the work of our world and of the universe.

A unity or identity of all force was asserted by Aristotle, and its verification has ever been sought for. To Faraday we owe its demonstration. He proved that all forms of force are resolvable into one another. Whatever name or designation we may give to its various forms, whether gravity, heat, light, etc., but one essence pervades and animates them all. This universal essence or force owes its genesis to the initial impulse which set all spheres in motion in space. What was actually the source of that initial impulse it is not necessary for us to know. The fact that these motions *are* is sufficient.

GRAVITY.

ITS ESSENTIAL NATURE, ELECTRICAL.

Chief among the manifestations of the universal force stands gravity, which reaches out to the boundaries of space and dominates all matter. It is surprising how simple is the interpretation which the electrical theory gives to the subject of gravity. It is known that all bodies susceptible to electrical excitation become centers of attraction through the operation of the electrical circuit. A body of soft iron is thus made magnetic and retains its power of attraction during its continuance in the circuit. So the sun and earth, being magnets excited into activity by their motions, become constituents in an electrical circuit, and both they and all things they contain thereby become thoroughly vitalized with the power which we call gravitation. Thus the relation between electricity and gravity is simply that of *cause* and *effect*.

The great Faraday was fully impressed with the idea of an electrical relationship between gravity and electricity, and for many years endeavored to demonstrate the same, but was unsuccessful. In view of his disappointment he once wrote: "Here end my trials for the present. The results are negative. They do not shake my strong feeling of the existence of a relation between gravity and electricity." We are told by his biographer that ten years afterwards, in the very last paper he wrote, he says the same thing in almost the same words. He found an insuperable difficulty in a purely inherent force of attraction and believed in the existence of some agent, at the time unknown, that was the cause of the attraction called gravitation? "For my own part," he says, "many considerations urge my mind towards the idea of a cause of gravity which is not resident in the particles of matter merely, but constantly in them and in all space." In other words, he believed that gravity is produced by some external agency

which would account for its varying degrees of force at different distances. He reiterates, "Nothing could be more in contrast with the assumed variable condition of the gravitating force supposed to reside in the particles of matter, than the known facts of gravity." In view of the fundamental importance of this philosophy, Faraday says: "The discovery of a relationship between gravity and electricity would have a bearing in importance beyond all conception in elucidating not only the facts connected with these subjects, but also others of a high importance, there being scarcely a limit to the subjects which would be illuminated by it."

Newton, the so-called father of gravity, has been most universally and persistently misrepresented in his philosophy of gravity. The theory that gravity is inherent in the particles and masses of matter, which is attributed to him, he condemns in Epicurus, who, he tells us, taught it 2,300 years ago. In writing to a friend, he desired that he would not attribute innate gravity to him. Thirty years subsequently to his enunciation of what are essentially his theories, and nine years before his death, he deemed it necessary to state that he did not, by any means, consider gravity an essential property of bodies. He regarded it rather as the result of some higher and still unknown power. "Gravity," he says, "must be caused by an agent acting constantly according to certain laws; but whether this agent be material or immaterial I have left to the consideration of my reader."

The conception that gravity was in some manner related to electricity was entertained in the time of Newton. Electrical science was then in but an incipient stage of development. It was not sufficiently advanced to be applied in explanation of the essential nature and operation of gravity, yet his teachings unmistakably point to electricity as the agency which he endeavored so earnestly to seek out. He says: "The ultimate particles of matter are endowed with inherent forces or powers of *attraction* and *repulsion*." Mark well that *repulsion* has never been taken into account in the popular or so-called

Newtonian theory of gravity. How significant! The great Newton thus shows his recognition of a certain and peculiar cause of gravity, which, in the more advanced light of to-day, we recognize to be electricity. The concluding page of the mathematical portion of his *Principia* points to electricity as the agent of gravity. His words are these: "Hitherto we have explained the phenomena of the heavens and of our sea by the power of gravity, but have not yet assigned the cause of this power. It is certain that it must proceed from a cause that penetrates to the very center of the sun and planets without suffering the least diminution of its force." No other power save electricity possesses the peculiar property of penetrating to the very center of the sun and planets without suffering the least diminution of its force.

Newton ends this, his masterpiece, with the following words concerning electricity: "And now we might add something concerning a most subtle Spirit which pervades and lies hid in all gross bodies, by the power and action of which Spirit the particles of bodies attract each other at near distances, and cohere if contiguous, and electric bodies operate to greater distances, as well repelling as attracting the neighboring corpuscles. But," he continues, "these are things that cannot be explained in a few words, nor are we furnished with that sufficiency of experiments which is required to an accurate determination and demonstration of the laws by which this electric or elastic Spirit operates."

Thus almost prophetically speaks Newton, as if dimly conscious that this spirit, so wonderful and mysterious, might yet afford the key to solve the old enigma of gravitation.

Nothing is clearer or more profoundly significant than the fact that Newton, instead of making gravity itself fundamental, sought earnestly for a cause of gravity. We find, in the more perfect data of to-day, ample proof that electricity is, in fact, what both he and Faraday obscurely suspected—the very agent sought for. No fact is now known to man which disproves the philosophy that electricity and gravity bear the relation of *cause* and *effect*.

SUNHEAT AND SUNLIGHT.

THE PHILOSOPHY OF THEIR PRODUCTION AND TRANSMISSION.

If our sun and the many millions of star-suns visible to the aided eye were incandescent, and incessantly disseminated heat and light in all directions and to all distances into space, through the process of radiation, as taught by science to-day, all space would be heated and lighted. There would be, therefore, neither cold nor night at the earth. The fallacy of present theories thus becomes most clearly and forcibly apparent. A better philosophy is needed.

We hold it to be a fundamental law that an equilibrium is constantly maintained among the members of our solar system, and, in fact, among all of the heavenly bodies, even to the extent that there can be no waste of substance, no dissipation of their energy. This necessitates an equivalent in income to every outgo. There can be in no sphere an expenditure of force not made good by the receipt of its exact equivalent. This is the law of conservation of force in its largest sense. To it we must hold. The science of to-day has antagonized this immutable law, especially as it pertains to our sun. It persistently teaches that the sun is wasting away, drained by what it gives to the celestial spheres. It presumes to substitute a new law, even the law of dissipation of force. The wastefulness implied in the current theory of sunheat and sunlight, the theory of universal radiation, is altogether beyond computation, involving, as it does, the shrinkage of the sun and the complete destruction of cosmical equilibrium. No cosmical theory should be for a moment tolerated which involves waste, yet *all* theories heretofore advanced are *based* upon the philosophy of actual dissipation. The electrical theory involves no waste.

We have seen that heat and light do not exist at the sun, neither are they found between the sun and earth outside of our atmosphere. In illustration of the action going on between the sun and earth we will suppose lines to be drawn from the sun to the earth, tangent to both; these lines will inclose a tapering space, the sun at the big end and the earth at the small end, giving to the space the form of a truncated cone. We will call this space the solar cone. Within this space there is an incessant circulation going on, and all the phenomena of heat, light and gravity are produced as the result of the activity of force playing between the sun and earth. But where is the place of manifestation--all along the space, or at the sun, or at the earth? We find the field of encounter between the forces to be the atmosphere. There the collision takes place, and there all heat and light are generated. There is no reason why there should be outside of this space a similar activity; for, being conditioned upon the three elements, sun, earth and atmosphere, we cannot look for heat and light except at the point where the requisite conditions are met.

Recent discoveries appertaining to the artificial production of electric light have revealed to us the secret of nature's process in the development of sunlight and sunheat. It is in this field that the dynamo-electric machine has done, perhaps, the most to interpret nature. An important element in electrodynamics is resistance. Light, heat and power are developed through the agency of resistance to the passage of the electrical current. By placing in the track of the current developed by the dynamo-electric machine certain bodies of a proper constitution a light is produced so remarkably similar to the light of the sun that the rational mind is forced to inquire if it be not in reality identical with it. It is plain, even upon a very slight examination, that there is a striking analogy between these two in several respects. The revolutions in the machine remind us of the revolutions in the heavenly bodies, while it is equally plain that magnets are involved in both cases. In either case, too, it is necessary that proper objects

of resistance to the current be introduced; in the dynamo-electric machine, the carbon point and the platinum coil, and on the grander scale of the spheres, the atmosphere. The remarkable magnetic constitution of the atmosphere gives it a peculiar and wonderful adaptability to that purpose. The intensest sunheat and sunlight are found always, other things being equal, where the atmosphere is densest or heaviest, namely, at the earth's surface. Just as the sun's heat decreases as we ascend mountains, so in a similar ratio does the sun's light decrease, and in both instances the fact is plainly due to the lessening density of the atmosphere and the consequent lessening resistance which it offers to the sun's currents. It is true that in the light, tenuous atmosphere of the summits of lofty mountains the human body often experiences the fiercest effects of sunheat, and that the *pyrheliometer* of Pouillet also records such effects. This is explained in the fact that these bodies receive the direct rays of the sun, unmuffled by the atmosphere, and that in them is developed a local heat that is far greater than that of the surrounding atmosphere, which is too tenuous to offer resistance.

The sun's current, like the electric current from the little machine, is invisible, gives no manifestation, passes through space like electricity through wires; without being itself hot, it develops heat; without being itself luminous, it develops light; and endues with attractive powers that which it pervades. The dynamo-electric machine thus becomes to us the interpreter of the universal phenomena. It teaches that potential action generated in a dark, cold body, may produce great heat, light and attraction at a distance from the seat of activity. What, therefore, can be wrought by us artificially and in a small way, may surely be done naturally and in a tremendous fashion, by the great forces of the sun. And it is here at the very surface of the earth where we dwell, that these manifestations and transmutations of force are wrought. It is here only that heat and light are developed. A distant manufacturing place or distributing

reservoir is not required. It is enough that there should be potential heat and light which may be developed into actualities at the place where they are needed. For anything that is known to the contrary, the sun may do all that it has to do and still be a habitable body.

That gravity acts instantaneously at all distances is unquestioned. If gravity, heat and light are due to identically the same process, heat and light must, like gravity, act instantaneously. Time and distance, therefore, cease to be factors in this problem. In view of this fact, the theory that thousands of years are required for light to reach the earth from certain fixed stars becomes an absurdity. If the most distant of those stars which is visible could be annihilated to-night, its light would be seen no more.

ORBITAL ELLIPTICITY, AN ELECTRICAL PHENOMENON.

Of the sufficiency of the electrical hypothesis to further explain the grand phenomena of the universe we may cite that of orbital ellipticity. As soon as the conception has been once entertained that the sun and earth and all related spheres are vast magnets, excited into activity by their motions, we are immediately impressed with the importance of that most striking fact, the polarity of those magnets, together with the associated phenomena of attraction and repulsion. Polarity is a fundamental law of electrical action, and no electrical effect can take place on the grandest or minutest scale except through its operation. If gravity be an electrical phenomenon, then the form of each planetary orbit must be determined by the uniformity or variation of the gravitational force. The very ellipticity of the form of the orbit, therefore, shows a varying attraction between the sun and earth which increases and diminishes with mathematical exactness and regularity.

The earth, sun and stars have their positive and negative poles, and are thus subject to the laws of electrical polarity. Unlike polarities attract and like polarities repel.

An electrical attraction existing between the spheres being already recognized, it becomes a matter of fundamental importance how the celestial bodies are arranged in relation to each other with regard to their polarities. This relative position depending, as it does, upon the inclination of the magnetic axes of the bodies, the necessity of the making account of the degrees and variations of inclination becomes apparent. There is a constant alternation of the polarity of the earth, caused by its revolution in its orbit. During half of the year the southern extremity of the earth's magnetic axis is presented towards the sun, and the earth is attracted towards that body, and during the succeeding half year the north pole is similarly presented, with a consequent repulsion, and by no other power may the earth be controlled in its course, with the inevitable result of an elliptical pathway. Thus when the earth's south pole is nearest the sun, about the twenty-first of December, the attraction between the two bodies is the greatest, and they are found in closest proximity; and when the earth's north pole is nearest the sun, about the twentieth of June, the attraction is the least, and the two bodies are found at their greatest distance apart, 3,000,000 miles further than in December. Thus orbital ellipticity is determined by electrical polarity.

THE EARTH'S AXIAL ROTATION, ELECTRICAL.

The conception of the earth and sun as magnets connects equally with axial rotation. Were it not for some special provision for axial rotation the earth would be held as in clamps between the so-called centripetal and centrifugal forces, and, like the moon, would show but one face to its primary. It is demonstrated that at precisely the same hour, *viz.*, two o'clock P. M., heat intensity and magnetic intensity are coincident.

From that hour each diminishes, and from morning until two o'clock P. M. each increases in the same ratio. During the night the magnetic condition is found most electro-negative at two o'clock A. M. Thus, at two o'clock P. M. the positive sun on the one hand and the positive earth at thirty degrees west meridian on the other hand, being in like condition, namely, electro-positive, mutually repel each other; and the consequent push moves the earth in revolution. The revolving earth turning eastward is continually carrying its negative condition of the night into the field of the positive sun. A mutual attraction, therefore, takes place, with a consequent pull on that side. Thus is engendered the process of an incessant attraction on the east side and of repulsion on the west side, giving to the earth its axial rotation.

We have thus endeavored, in a brief and suggestive way, to show the essential nature and constitution of the sun, with the mode of performance of its grand functions. In this new interpretation given to the sun we have presented the outlines of a cosmical philosophy at once rational, concise, exact and new: which philosophy may be distinctively entitled, **THE ELECTRICAL THEORY OF THE UNIVERSE.**

This electrical theory is not devoid of mystery and difficulties, but time may be trusted to remove them. It simplifies so many problems, clears up so many obscurities, opens so extended a range of new investigations, and contrasts so strongly with the complexities and incongruities of the older theories as to leave little choice between the opposing theories.

Finally, among all scientific facts, none is more impressive than the grand fact that the earth, and the sun, and all the heavenly bodies are possessed with reciprocal electrical energy, by virtue whereof they exert a powerful influence over each other and give rise to all the phenomena, terrestrial and celestial, that make up the subject matter of scientific study.

APPENDIX.

SUN-SPOTS.

If the grander phenomena of the sun—its gravity, heat and light, and its elliptical and axial rotations—are essentially electrical, it may be supposed that its lesser manifestations, as sun-spots, corona, prominences or red flames, etc., may also be electrical in character. No interpretation of sun-spot phenomena ever yet advanced has proved satisfactory. So varied and contradictory are these manifestations that they cannot be explained upon any principles of philosophy already established.

Three different kinds of sun-spots are known. The first of these is of dazzling brightness and of short duration. This form is rarely observed. The other forms are commonly represented as black. Of these, the one is more permanent in its duration; in some instances being visible for many months. The other is short-lived, sometimes coming into the field of view almost instantaneously, and not unfrequently disappearing as quickly. The dark spots are represented by nearly all scientific teachings and by pictorial illustrations as black. This is misleading, as their darkest portion, or umbra, is known to be intrinsically bright; according to Zöllner, 4,000 times as bright as an equal area of the moon.

Both the bright spots and the darker have been known to occupy apparently the same area at the same time; the bright spots moving with a velocity of 120 miles per second over the face of the darker spot, without visible interference on the part of either. This fact is of fundamental importance in determining the essential character of this phenomenon. Two astronomers who viewed this double spot from localities widely separated, report that two dazzling spots suddenly burst into

sight at the edge of a large dark spot which they were observing. These bright spots moved eastward over the face of the darker one, in parallel lines, for the distance of 36,000 miles, gradually growing smaller and fainter and disappearing in about five minutes.

Simultaneously with the appearance of these bright spots violent electrical effects occurred over a large portion of the earth. In Norway, in a telegraph office, the operator was stunned and his instrument set on fire; a stream of fire followed Bain's electric pen in Boston; and self-registering magnetic machines were disturbed over both continents. We are told by a distinguished scientist that this event has become classical.

The celerity of movement which is observed in these spots renders it impossible that they should take place at the sun. When we consider that in order to be visible a spot must cover an area of at least 10,000 square miles, that single spots and groups of spots cover very many thousand times that area, we recognize the fact that gases, or more material substances, can by no possibility move with the requisite velocity. These substances, therefore, can have no part in the phenomenon.

Single spots and groups of spots come into the field of view almost instantaneously and as suddenly disappear. Thus, Krone saw a spot of no inconsiderable dimensions which sprang into existence in less than a minute of time. Dr. Wollaston says: "I once saw a spot which burst in pieces as I was looking at it." Sir William Herschel turned away his eyes from a group of spots he was observing, and when he looked again the group had vanished.

It is rational to suppose that the various spot manifestations are capable of explanation upon one and the same principle of philosophy. Its spots of dazzling brilliancy; its darker forms, both the more permanent and the evanescent; the simultaneous occurrence of its bright and dark forms within the same area and without interference; its incomprehensible velocities and electrical effects—all these should be accounted for upon

a single principle of explanation; and, too, this explanation should not conflict with the hypothesis of identity of constitution of sun and earth.

In view of the foregoing facts the inference becomes legitimate that this phenomenon is not due to a violent turmoil among the particles of any element now recognized as substantial and located at the sun; that it is not due to a force inherent in the sun itself, by which its body or surroundings may be thrown into convulsions on such a stupendous scale as to be seen from the earth. The so-called sun-spot, therefore, cannot be located at the surface of the sun—it cannot be real, it can only be apparent. Scheiner was one of the first who ever observed these spots through a telescope and was, therefore, uncontrolled by theories in his estimate of their character and location. He held it "impossible that they could be on the sun itself," and imagined some of them to be "as far from the sun as the moon, Venus or Mercury."

We have seen that the darkest sun-spots are actually bright, that the bright spots are dazzling in their brilliancy, and that violent electrical effects, reaching out to the earth, are due to their action; we are therefore forced to the conclusion that all spot manifestations are due to electrical causes, and owe their existence to modifications of the sun's light. If due to such modifications of light, and light be an electrical phenomenon, then must all explanations be sought for in the field of electricity. In other words, this phenomenon, like gravity, sun-heat and sunlight, is purely electrical. Upon this hypothesis, and upon no other, may *all* its facts be explained.

We have found that the sun is not essentially bright, that its supposed brilliancy is located in our atmosphere, and that this brilliancy is caused by the action of electrical sun-currents upon the earth's atmosphere. The conclusion becomes necessitated that any increase or diminution of the apparent light of the sun, over larger or smaller areas or spots, must be caused by an interruption of development or continuity on the part of those currents.

The question arises, how may this great cosmical sun-current, incessantly in play between the sun and earth, be interfered with in its development or its transmission? Humboldt tells us that magnetic storms are constantly in action within our earth, over larger or smaller areas. Inferentially, we may suppose that such storms are in action at the sun in immeasurably greater magnitude. In these perturbations within the sun and earth we find abundant cause for such disturbance of development or continuity of the great terra-solar electrical current as might give rise to the so-called sun-spots.

THE CORONA.

A halo or aureola of light apparently surrounds the sun during a total eclipse, and bright rays appear to project outward from it in various directions and in manifold forms. This beautiful object is the corona, or, as it is sometimes called, the "glory." In the past it has been supposed to be a phenomenon occurring at the sun, and this conception is yet held by high authorities, but at the present time much diversity of opinion exists among scientists as to its essential nature and its location. Mr. Lockyer says of the corona: "It is bizarre and puzzling to the last degree." Prof. Young tells us that, "All we can say with certainty upon this subject is that we know nothing about it. We can hardly say that we know anything more about the corona than the first observer who ever saw it might have guessed by simply looking at it."

The telescope is wholly unreliable when employed in the investigation of the essential nature of the sun or the character of its apparent surroundings. This fact is demonstrated in the following incidents: A certain total eclipse was observed by several most distinguished astronomers, each a trained expert in this field. Their special task in this case was to draw the corona; yet we are told by one of their number that they all differed about the direct ocular evidences, for each seemed

to have seen a different corona, and the drawings were singularly unlike; no one could guess that they represented the same object. He also says: "I hardly know a more striking instance of the fallibility of human testimony." Again, in 1870, two naval officers on the deck of the same vessel, side by side, made drawings of a corona, one of which represented it as a six-rayed star, while the other showed it as composed of two ovals crossing at right-angles.

The opinion that the corona is not an appendage of the sun is held by distinguished scientists at the present time. Mr. Lockyer says: "I confess the conviction that the corona is nothing else than an effect due to the passage of sunlight through our own atmosphere." This philosophy is even now virtually demonstrated. A recent attempt to photograph a corona gave the following results, viz., the corona in front of the moon was quite as well marked as that on the side of the sun; indeed, the most corona-like ray produced appeared in one photograph stretching directly towards and terminating at the center of the moon. Thus it is actually demonstrated that the corona is not a portion of the sun's surroundings, that it is not located at the moon. It therefore becomes a legitimate conclusion that it is mainly located in our atmosphere.

PROMINENCES, PROTUBERANCES, RED FLAMES, ETC.

The scientist of to-day believes that he sees around the sun what resembles a sheet of scarlet fires, as if countless jets of heated gas were issuing from its surface. But in the study of this phenomenon, as in that of the corona, the telescope is practically worthless. The eclipse of 1842, which first directed any considerable attention to this subject, was of exceptional brilliancy, and was viewed under the most favorable conditions. It was observed by many of the most noted astronomers, uninfluenced by established theories or conceptions. The phenomenon was regarded with extreme surprise, and became the

object of warm discussions, not only as to its cause and location, but even as to its very existence. Some thought it constituted of mountains upon the sun, some of solar flames, and others, clouds floating in the solar atmosphere; others referred it to the moon, and yet others to our atmosphere, and not a few believed it to be a mere optical illusion or mirage. No data more reliable have since been discovered.

If the sun and its surroundings are constituted like the earth then its actual location cannot be at the sun. It must be sought for in some locality nearer the earth, presumably in our atmosphere. We are, in fact, told by a distinguished spectroscopist that "the air, the cloud, everything between us and the dark moon gives the same spectrum as we get from the prominences themselves." Therefore, we have abundant reason to infer that this, like the corona, has its location in our atmosphere. No longer need we regard the sun as surrounded with fantastic fringes, such as are commonly pictured in the illustrations of the prominences. . . .

ZODIACAL LIGHT.

The fact that this phenomenon is observed soon after the sun's disappearance below the horizon, or before its re-appearance, stamps it as purely atmospheric in its locality. That it is essentially electrical in its character appears unquestionable. Thus, Humboldt, who had rare opportunities for observing it in all its varying conditions, north and south, says: "When the zodiacal light had been most intense I have observed that it would be perceptibly weakened for a few minutes, until again it suddenly shone forth in full brilliancy. In some few instances I have thought I could perceive a kind of flickering or waving of the light." Other observers have seen "the lower portion darkened in an arc-like form," "scintillations," "flickering," etc. These conditions show this phenomenon to be both atmospheric and electrical.

In conclusion, it is apparent that electricity is vital and fundamental in the production and operation of all the phenomena of nature. Accordingly we have made the attempt to bring certain fundamental facts into unity for the construction of a rational philosophy; or at least to mark some of the leading outlines of such a philosophy, and to indicate the direction of its future development.

We cannot more fittingly close these pages than in the use of the words of the great Faraday, who was, perhaps, the most distinguished man in this field which the world has ever known:

“When we remember that the earth itself is a magnet, pervaded in every part by this mighty power, universal and strong as gravity itself, we cannot doubt that it is exerting an appointed and essential influence over every particle of matter and in every place where it is present. What its great purpose is, seems to be looming up in the distance before us; the clouds which obscure our mental sight are daily thinning, and I cannot doubt that a glorious discovery in natural knowledge, and in the wisdom and power of God in the creation, is awaiting our age.”

